UNITED STATES MARINE CORPS
Logistics Operations School
Marine Corps Combat Service Support Schools
Training Command
PSC Box 20041
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AIM 5403

STUDENT HANDOUT

REBUILD DETROIT 8V92TA ENGINE

LEARNING OBJECTIVE

1. TERMINAL LEARNING OBJECTIVE: Given a Detroit 8V92TA engine, the required tools, shop supplies, repair parts, TM 9-2320-297-20, and TM 9-2320-297-34, per information contained in the references, repair the engine. (5.4.4)

2. ENABLING LEARNING OBJECTIVES: Given a Detroit 8V92TA engine, the required tools, shop supplies, repair parts, TM 9-2320-297-20, and TM 9-2320-297-34, per information contained in the references:

a. disassemble the upper cylinder mechanism, (5.4.4a)

b. inspect the disassembled components for serviceability, (5.4.4b)

c. repair or replace the unserviceable components, (5.4.4c)

d. assemble the engine from serviceable components, and (5.4.4d)

e. perform the final engine run-in adjustments. (5.4.4e)

OUTLINE

1. DESIGN CHARACTERISTICS AND PRINCIPLES OF OPERATION OF THE DETROIT 8V92TA DIESEL ENGINE

a. The numbers and letters in the model of the engine describe what type of Detroit diesel engine you have. This model is an 8V92TA which means it has eight cylinders in a V-type configuration, 92 cubic inches per cylinder, is turbocharged and has an aftercooler. The 8V92TA has a rated horsepower of 445 to 475, depending on the year, and reaches its peak torque of 1250 foot pounds at 1300 rpm. The maximum no-load speed is set at 2250 rpm and the engine firing order is 1L, 3R, 3L, 4R, 4L, 2R, 2L, 1R.

b. The Detroit diesel engine is a two cycle (also called two stroke) engine. This means that one complete cycle; intake, compression, power, and exhaust, occurs every time the piston goes up and down. Up is one stroke, and down is one stroke. This is possible because the air intake and exhaust functions are accomplished during the compression and power strokes. This is very different from four cycle (also called four stroke) engines, which use one extra stroke for air intake, and one extra stroke for exhaust. Thus, two cycle engines produce as much power as four cycle engines, using half the number of strokes.

c. The engine has a turbocharger and a blower to force air into the cylinders (called supercharging) for both the intake and the exhaust functions. When the piston is halfway down, the exhaust valves open. Shortly thereafter, the piston drops below a row of inlet ports in the cylinder liner wall. Supercharged air is then allowed to pass through the cylinder. During this process, all of the exhaust gases are removed, or scavenged, from the cylinder. When the exhaust valves close, during the piston's upward stroke, fresh air is trapped in the cylinder for compression.

d. Shortly before the piston reaches its highest point, the required amount of fuel is injected into the cylinder. The intense heat that is created by the high compression of the air immediately ignites the fine fuel spray. The combustion continues until the injected fuel has burned.

e. The resulting pressure forces the piston downward on its power stroke. When the piston is about halfway down, the exhaust valves open. Shortly thereafter, the piston drops below the ports, and the cylinder is again swept with clean scavenging air. This entire combustion cycle is completed in each cylinder for each revolution of the crankshaft. In other words, one cycle is completed with every two strokes of the piston.

f. <u>Nomenclature, Purpose and Location of the External Engine Components</u>

(1) Oil filter and adapter. The oil filter is a spin-on type that attaches to the oil filter adapter. The adapter has a bypass valve that opens at eighteen to twenty-one pounds of pressure per square inch (124-145 kPa). This means the bypass valve will open if the oil filter becomes clogged.

(2) Fuel supply pump. It is a positive displacement, gear-type fuel pump that is attached to the governor housing and is driven off the right hand blower rotor by means of a drive coupling fork. The fuel pump is not timed because the fuel injectors are self timing.

(3) Shutdown solenoid. It is an electrically controlled solenoid used to shut down or stop the engine. The solenoid is attached to the stop

lever on the governor. When activated, the shutdown solenoid pulls in the stop lever. The stop lever operates a series of internal fuel rods to shut off the fuel flow within the injectors.

(4) Throttle cylinder. It is an air actuated cylinder that is controlled by the throttle treadle valve. The throttle cylinder attaches to the speed control lever on the governor. When regulated air reaches the cylinder, a push rod moves the speed control lever. The control lever moves internal fuel rods and levers that regulate the amount of fuel in the injector.

(5) Thermostats and housing. The engine coolant temperature is controlled by two thermostats. Each thermostat is located in a housing attached to the water outlet end of each cylinder head.

(6) Water pump. It is a centrifugal-type pump mounted on the engine front cover and is driven by the right front camshaft gear.

(7) Oil cooler. It cools the engine oil by sending it through plates that are surrounded by engine coolant.

(8) Governor. The governor is a double-weight, limiting speed governor. The governor has the following two functions:

(a) Controls the engine idling speed.

(b) Limits the maximum operating speed of the engine.

(c) Any speed above idle and below maximum is controlled by the operator.

(9) Turbocharger. The turbocharger, commonly called a turbo, is essentially an exhaust driven blower, the purpose of which is to increase the engine power by supplying compressed air to the engine combustion chamber. The turbo is not connected to the engine power train; therefore, it is not a horsepower parasite during operation. The unit automatically responds to the engine load demands without any control connections between the turbo and engine.

(a) On a naturally aspirated diesel engine (one without blower or turbo), air enters at atmospheric pressure, is injected with a specified amount of fuel, and is burned in the combustion chamber, developing power.

(b) On a turbocharged engine, the turbo supplies air under pressure to the engine. Thus, a greater amount of air enters the combustion chamber. The fuel system is designed to provide the correct amount of fuel for the increased supply of air. The increased air-fuel mixture enables the engine to develop more power.

1 The turbo is driven by the engine exhaust which is directed into the turbine housing, where it gains velocity and strikes the turbine wheel. This action spins the turbine wheel and shaft to which the compressor wheel is attached.

2 The turning of the compressor wheel draws air in through the filter system into the compressor housing. The air is centrifugally compressed and forced into the intake system. This provides a greater volume of air to the combustion chamber, allowing more fuel to be delivered, resulting in more power output for the engine.

(c) The turbocharger is pressure lubricated by the engine lubrication system by external lines. Oil flows through the bearing housing and around the bearings which support the turbine shaft. The oil returns to the engine by gravity through return lines. The lube oil reduces friction and aids in the cooling of the internal parts of the turbo.

(10) Blower. The blower supplies fresh air needed for combustion and for scavenging exhaust gases.

(a) In the scavenging process employed in the 8V92, a continuous charge of air is forced into the cylinders by the blower. This air thoroughly sweeps out all of the burned gases through the exhaust valve ports and helps to cool the internal engine parts, particularly the exhaust valves. Therefore, at the beginning of the compression stroke, each cylinder is filled with fresh, clean air which provides for efficient combustion.

(b) The air, entering the blower from the air cleaner, through a turbocharger, is picked up by the blower rotor lobes and carried to the discharge side of the blower. The continuous discharge of fresh air from the blower enters the air chamber of the cylinder block and sweeps through the intake ports in the cylinder liners.

(c) The angle of the ports in the cylinder liners creates a uniform swirling motion to the intake air as it enters the cylinders. This motion persists throughout the compression stroke and facilitates scavenging and combustion.

(d) To put it simply, we could say that the blower, designed especially for efficient diesel engine operation, supplies the fresh air needed for combustion and scavenging. You could also say that its operation is similar to that of a gear-type oil pump, in that two, hollow, three-lobe rotors revolve with very close clearances in a housing bolted to the top deck of the cylinder block, between the two banks of cylinders. Also, that the helical (spiral) design of the rotor lobes provides the continuous, uniform displacement of air.

(11) Alternator. It is a flange mounted alternator that is driven by the blower drive gear by means of a drive coupling.

(12) Jacobs engine brake. The Jacobs engine brake is a device that alters the operation of the MK48 engine to permit it to aid in slowing the vehicle down when it is activated. This unit consists of brake housing assemblies that are located under the rocker covers, a buffer switch on the governor housing, and two control switches in the vehicle cab.

(a) When the vehicle operator activates the Jacobs engine brake by turning the control switch in the cab to ON and selecting either the HIGH or LOW braking action, the engine becomes an air compressor, when the operator is not pressing down on the throttle treadle valve. Instead of a power gain as the result of combustion and the resulting power stroke, there is a net power loss because the engine uses power to compress the air in the cylinders. The Jacobs engine brake accomplishes this by controlling the action of the exhaust valves.

(b) Basically, this is how the Jacobs engine brake controls the exhaust valves:

1 When the operator activates the Jacobs engine brake, a solenoid opens an oil passage and allows engine oil to flow under pressure through a control valve and on to the top of a master piston and slave pistons contained in the brake housings. If HIGH was selected, all eight cylinders are effected; if LOW was selected, only the four left hand cylinders are effected. The master piston is located above the injector push rods and the slave pistons are above the exhaust valves. Once the oil flows past the control valve, it is trapped by a ball check valve between the master piston and slave piston. It stays in this area as long as the Jacobs engine brake is applied.

2 Each time an injector push rod starts up on its injection stroke, the master piston is forced upward. The movement of the piston pressurizes the engine oil that is on the top of the piston and this pressure is transferred to the slave piston. Remember, this oil is trapped between the master and slave pistons by the ball check valve in the control valve. When the pressure is great enough, it overcomes a spring in the slave piston and the slave piston moves down. The downward movement of the slave piston forces the exhaust valves to open momentarily. At this time, the piston in the cylinder is near its top dead center position. With the exhaust valves open, the compressed air in the cylinders is released into the atmosphere through the exhaust system.

3 The sequence of events just described takes place every time a cylinder is due to fire, as long as the Jacobs engine brake is activated and the operator has the drive train in lockup and he or she does not have the throttle treadle valve pushed down.

(13) Fuel injector.

(a) It is a needle valve injector made by Detroit. We will cover it in more detail when we get into the fuel system.

(b) Repair of the fuel injectors is taught in a separate course.

(14) Throttle delay. This device reduces the exhaust smoke during acceleration. It delays the action of the governor by hydraulically holding the control tube until the spring force moves the throttle delay piston. The movement of the piston is restricted by the oil it must force out of the cylinder through a small orifice. This action slows the rotation of the control tube and thereby the movement of the fuel rack. As engine speed increases, the density of the exhaust smoke is gradually reduced. I will explain its operation in more detail when we get into the fuel system.

(15) Cylinder heads.

(a) The cylinder heads, one on each cylinder bank, are one piece castings held securely to the cylinder block by special capscrews. The exhaust valves, four per cylinder, fuel injectors, one per cylinder, and the valve operating mechanism are located in the cylinder head.

(b) Exhaust valve seat inserts pressed into the cylinder head permit accurate seating of valves under varying conditions of temperature. This significantly prolongs the life of the cylinder head.

(c) The exhaust passes through passages from the exhaust valves of each cylinder head through a single port to the exhaust manifold. The exhaust passages and the injector tubes are surrounded by engine coolant.

(d) In addition, cooling of the above areas is accomplished by the use of water nozzles pressed into the water inlet ports in the cylinder head. The nozzles direct the comparatively cool engine coolant at high velocity toward the sections of the cylinder head that are subjected to the greatest heat.

(e) The fuel inlet and outlet manifolds are integral parts of the cylinder heads. Tapped holes are provided for connection of the fuel lines at various points along each manifold.

(16) Valve operating mechanism.

(a) Three rocker arms are provided for each cylinder. The two outer arms operate the exhaust valves, and the center arm operates the fuel injector.

(b) Each set of three rocker arms pivots on a shaft supported by two brackets. A single bolt secures each bracket to the top of the cylinder head. Removal of the two bracket bolts permits the rocker arm assembly for one cylinder to be raised, providing easy access to the fuel injector and the exhaust valve springs.

(c) The rocker arms are operated by a camshaft, through cam followers and short push rods that extend through the cylinder head. Each cam follower operates in a bore in the cylinder head. A guide for each set of three cam followers is attached to the bottom of the cylinder head to retain the cam followers in place and to aline the cam follower rollers with the camshaft lobes.

(d) A coil spring inside each cam follower maintains a predetermined load on the cam follower to make sure there is contact of the cam roller on the camshaft lobe at all times.

g. <u>Construction Features of Internally Mounted Engine Components</u>

(1) Piston and connecting rod assembly.

(a) The cross-head piston is a two-piece piston consisting of a crown, which has the compression ring grooves, and the skirt. The skirt has oil ring grooves. These are held together by the piston pin. A slipper bearing is locked in the upper half of the piston pin bore. The connecting rod is bolted to the piston pin.

(b) With the cross-head piston design, the force of combustion from the piston crown goes directly onto the slipper bearing and piston pin. The skirt, being separate, is free from vertical load distortion. It is also free from thermal distortion, since the hotter crown expands during engine operation.

(2) Cylinder liner.

(a) The cylinder liner is of the replaceable wet-type, water above ports, made of hardened cast iron alloy, and is a slip fit in the cylinder block. The liner is inserted in the cylinder bore from the top of the cylinder block. The flange at the top of the liner fits into a counter bore in the cylinder block and rests on a replaceable cast iron insert that permits accurate alignment of the cylinder liner.

(b) Two teflon-coated seal rings, recessed in the cylinder bore, are used between the liner and the block to prevent water leakage.

(c) The upper half of the liner is directly cooled by the water surrounding the liner. At the air inlet ports, the liner is cooled by the air introduced into the cylinder through equally spaced ports around the liner. The lower half of the liner is cooled by water inside the cylinder block water jacket that surrounds the liner.

(d) The air inlet ports in the liner are machined at an angle that makes the air move in a uniform swirling motion as it enters the cylinder. This motion persists throughout the compression stroke and helps scavenging and combustion.

(e) The wear on a liner or piston is directly related to the amount of abrasive dust and dirt introduced into the engine combustion chamber through the air intake. This dust, combined with lubricating oil on the cylinder wall, forms a lapping compound and will result in rapid wear. Therefore, to avoid pulling contaminated air into the cylinder, the air cleaners must be serviced regularly according to the surroundings in which the engine is operated.

(3) Camshafts.

(a) The two, counterrotating camshafts are located just below the top of the cylinder block. A left cylinder bank and a right cylinder bank camshaft is provided to actuate the exhaust valve and injector operating mechanism. Camshafts have three lobes per cylinder. The two outside lobes actuate the exhaust valve mechanism and the middle one actuates the fuel injector mechanism.

(b) Both ends of each camshaft are supported by a bearing assembly that consists of a flanged housing and two bushings. In addition, three intermediate, two-piece bearings support the camshafts at uniform intervals throughout their length. The intermediate bearings are secured around the camshaft by lock rings that permit the bearings to be inserted in the cylinder block with the shafts. Each intermediate bearing is secured in place, after the camshafts are installed, with a lock screw that is threaded into a counterbored hole in the top of the cylinder block.

(c) The camshaft gear thrust load is absorbed by four thrust washers, one at each end of both rear camshaft end bearings.

(d) A camshaft front pulley, with integral weight, is attached to the front end of the left bank camshaft, and a water pump drive gear, with bolt-on weight, is attached to the front end of the right bank camshaft. A camshaft gear is attached to the rear end of each camshaft.

(e) Lubricating oil is supplied under pressure to the bearings by way of drilled passages in the rear of the cylinder block that lead from the main oil gallery to each rear end bearing. From the rear end bearings, the oil passes through the drilled oil passages in the camshafts to the intermediate bearings and to the front end bearings.

(f) The lower halves of the camshaft intermediate bearings are grooved along the horizontal surface that mates with the upper halves of the bearings. Oil from the passage in the camshaft is forced through the milled slots in the bearing and then out of the grooves to furnish additional oil to the cam follower rollers. This permits the cam pocket to fill rapidly to operating oil level, immediately after the engine is started.

(4) Crankshaft.

(a) The crankshaft is a one-piece steel forging, heat-treated to give it strength and durability.

(b) Complete static and dynamic balance of the crankshaft has been achieved by counterweights incorporated on the crankshaft.

(c) The crankshaft end play is controlled by thrust washers located at the rear main bearing cap of the engine. Full pressure lubrication to all connecting rod and main bearings is provided by drilled passages within the crankshaft and cylinder block.

(5) Cylinder block.

(a) The main structural part of the engine is a one-piece casting, made of cast iron alloy.

(b) The cylinder block liner bores are the wet-type above the cylinder liner ports and a dry-type below the cylinder liner ports. The water jacket and air box are sealed off by two seal rings compressed between the cylinder liner and the grooves in the block.

(c) An air box between the cylinder banks and extending around the cylinders at the air inlet port belt conducts the air from the blower to the cylinders. Air box openings on each side of the block permit inspection of the pistons and compression rings through the air inlet ports in the cylinder liners. The air box openings in the cylinder block assembly are covered with cast covers.

(d) The camshaft bores are located on the inner side of each cylinder bank near the top of the block.

(e) The upper halves of the main bearing supports are cast into the block itself. The main bearing bores are line bored with the bearing caps in place to make sure the longitudinal alignment is true. Drilled passages in the block carry the lubricating oil to all moving parts of the engine, eliminating the need for external piping.

(f) The top surface of each cylinder bank is grooved to accommodate a block-to-head oil seal ring. Also, each water or oil hole is counterbored to provide for individual seal rings. The same size seal rings are used at all counterbored oil and water holes in the cylinder block.

(g) Each cylinder liner is retained in the block by a flange at its upper end. The liner flange rests on an insert located in the counterbore in the block bore. An individual compression gasket is used at each cylinder.

2. DESCRIPTION, NOMENCLATURE, AND PRINCIPLES OF OPERATION OF THE FUEL SYSTEM AND ITS COMPONENTS

a. Overview

(1) The fuel pump draws diesel fuel from the tanks through the fuel/water separator and a one-way check valve. At the fuel pump, the fuel pressure is increased to approximately sixty pounds per square inch. After leaving the fuel pump, the diesel fuel goes through a secondary fuel filter. From the filter, it goes to each cylinder head by way of two separate fuel lines.

(2) Fuel is then directed into the inlet manifold of each cylinder head. Fuel goes through the manifold and out to the injector inlet by way of fuel connector pipes. Fuel then flows through the injector, which meters the amount injected, depending upon the engine load. The amount of fuel is mechanically determined by way of the injector control tubes and limiting speed governor.

(3) The remaining fuel circulates through the injector and helps to cool and lubricate it. Fuel leaves the injector through the return fuel connector pipe and travels to the return manifold cast inside the cylinder head. Fuel flows out of the cylinder heads to a restricted fitting. This restricted fitting maintains manifold pressure within the cylinder heads.

From the fitting, fuel flows through a single fuel line back to the right fuel tank.

b. Components

(1) Fuel tanks. There are two, seventy-five gallon diesel fuel tanks. One fuel tank is mounted on each fender, above the No. 2 axle.

(2) Fuel/water separator. It is a three-stage device used to separate water from fuel and filter out solid particles. In the first stage, a centrifuge separates large solid particles and water from the fuel. The water and large particles sink to the bottom of the fuel bowl where they remain, because they are heavier than fuel, until the fuel bowl is drained. In the second stage, any water that is still in the system condenses on the separator shell. When droplets form, their weight causes them to fall to the bottom of the fuel bowl. In the third stage, a replaceable filter element traps solid particles still in the fuel.

(3) Priming pump. It is a hand pump used to prime the fuel system when air has entered the fuel system, as when the vehicle has run out of fuel. After air has entered the system, the system must be primed before the engine will start.

(4) Fuel pump. The fuel pump is a positive displacement, gear-type pump. The pump is attached to the governor housing. It is driven off the end of the right-hand helix blower rotor by means of a drive coupling. Incorporated in the fuel pump is a spring-loaded relief valve. The pressure relief valve relieves discharge pressure by sending the fuel from the outlet side of the pump to the inlet side when the discharge pressure reaches about sixty-five to seventy-five pounds per square inch.

(5) Secondary filter. It is a replaceable filter that traps extremely fine particles that have passed through previous filtration.

(6) Fuel manifold and pipes. They are drilled passages within the cylinder head that route fuel to and from the injectors. Fuel pipes provide the means for direction of fuel from the cylinder head manifolds to the injectors.

(7) Injector control tubes.

(a) The two fuel injector control tube assemblies are mounted on the left and right bank cylinder heads of the engine. Each tube assembly consists of a control tube, injector rack control levers, a return spring, and injector control tube lever mounted in two bracket and bearing assemblies attached to each cylinder head.

(b) The control tube is connected to the injector control racks and the governor. The control tubes keep the injectors balanced together and provide the mechanical means for the right amount of fuel to run the engine under varying loads and speeds.

(8) Governor operation.

(a) When the engine is not operating, the force of the high-speed spring holds the high-speed plunger against its stop, and the low-speed spring holds the low-speed spring cap against the gap adjusting screw, which is located on the operating shaft lever. The expanded springs pivot the operating shaft lever, making the operating fork rest against the thrust bearing and the riser rest against the low-speed and high-speed weights.

(b) The governor starting aid screw holds the injector racks in the advanced fuel position for starting when the speed control lever is in the idle position. Immediately after starting, the governor moves the injector racks to the position required for idling.

(c) The centrifugal force of the revolving governor low-speed and high-speed weights is converted into linear motion that is transmitted through the riser and the operating shaft to the operating shaft lever. One end of this lever operates against the high-speed and low-speed springs through the spring cap, while the other end provides a moving fulcrum on which the differential lever pivots.

(d) When the centrifugal force of the revolving governor weights balances out the tension on the high-speed or low-speed spring, depending on the speed range, the governor stabilizes the engine speed for a given setting of the speed control lever.

(e) In the low-speed range, the combined centrifugal force of the low-speed and high-speed weights operates against the low-speed spring. As the engine speed increases, the centrifugal force of the low-speed and high-speed weights compresses the low-speed spring until the low-speed weights are against their stops, thus limiting their travel. At this time, the low-speed spring is fully compressed.

(f) The engine idle speed is determined by the force exerted by the governor low-speed spring. When the governor speed control lever is placed in the idle position, the engine will operate at the speed where the force exerted by the governor low-speed weights will equal the force exerted by the governor low-speed spring.

(g) Throughout the intermediate speed range, the operator has complete control of the engine because both the low-speed spring and the low-speed weights are against their stops, and the high-speed weights are not exerting enough force to overcome the high-speed spring.

(h) As the speed increases, the centrifugal force of the high-speed weights increase until this force can overcome the high-speed spring. At this point the governor again takes control of the engine, limiting the maximum engine speed.

(i) Fuel rods are connected to the differential lever and injector control tube levers through the control link operating lever and connecting link. This arrangement provides a means for the governor to change the fuel settings of the injector control racks.

(j) Adjustment of the engine idle speed is accomplished by changing the force on the low-speed spring by means of the idle adjusting screw.

(k) The engine maximum no-load speed is determined by the force exerted by the high-speed spring. When the governor speed control lever is placed in the maximum speed position, the engine will operate at a speed where the force exerted by the governor high-speed weights equals the force exerted by the governor high-speed spring.

(l) Adjustment of the maximum no-load speed is accomplished by the high-speed spring retainer. Movement of the high-speed spring retainer will increase or decrease the tension on the high-speed spring.

(9) Throttle delay mechanism. A throttle delay mechanism is employed in turbocharged engines such as the 8V92TA to retard full-fuel injection when the engine is accelerated. This reduces exhaust smoke during acceleration and helps improve fuel economy.

(a) When the vehicle operator pushes the throttle treadle valve down to increase engine speed, the turbocharger tends to lag momentarily. At this time, the fuel injectors are capable of delivering more fuel than the engine can use in relation to the amount of air that is available for the combustion process. If the engine was not equipped with a throttle delay mechanism, an overfueling condition would exist during initial acceleration and the result would be offensive black smoke and less than desirable fuel economy. This is how the throttle delay mechanism works.

(b) When the operator releases pressure on the treadle valve, a piston in the throttle delay mechanism is pulled down in its cylinder by linkage that is connected to the injector control tube. During this movement to a no fuel condition, the piston passes a hole in the delay mechanism special rocker arm bracket. Above the hole is a reservoir of engine oil that is supplied by a drilled passage in the rocker arm shaft bracket. When the hole below the reservoir is uncovered, the oil in the reservoir runs into the space in front of the piston head in the throttle delay mechanism cylinder. At this time, the delay mechanism is ready to function.

(c) When the operator attempts to accelerate, the movement of the injector control tubes and injector racks to the full-fuel position is momentarily retarded while the oil is being expelled from the cylinder through a small orifice by the movement of the delay mechanism piston.

(d) The throttle delay mechanism is installed between the No. 1 and No. 2 cylinders on the right cylinder bank. The complete mechanism also includes a yield link in place of the standard operating lever connecting link in the governor. This yield link, as the name implies, yields when the treadle valve is pushed and prevents damage to the various throttle linkages while the throttle treadle valve is depressed, but movement of the injector racks is being prevented by the operation of the throttle delay mechanism.

(10) Detroit fuel injector.

(a) The fuel injectors used in the Detroit 8V92TA diesel engine are needle type injectors. The engine has one injector for each cylinder, and they are mounted in the cylinder head, directly over each piston.

(b) A metal tag pressed into the injector body identifies the injector for a particular engine application. The one thing you need to remember is to always use injectors with the same numbers in all eight cylinders. Otherwise the engine will not perform at full potential. The metal tag identifies the model number of the injector. The model number for the ones used in the LVS is 9A90.

(c) The injectors are mechanically operated by the camshaft, cam followers, push rods, and rocker arms.

(d) The injection timing is controlled by the camshaft.

(e) The fuel injector performs four functions (times - atomizes - meters - pressurizes):

1 accurately times the moment of fuel injection,

2 atomizes the fuel for vaporization and mixing with the air in the combustion chamber,

3 meters and injects the correct amount of fuel required to maintain engine speed and to handle the load, and

4 creates the high pressure required for proper fuel injection.

(f) Fuel enters the injector when the follower is at the top of the stroke. As the injector follower pushes down on the injector plunger, this action subjects the fuel to increased pressure in the injector. When sufficient pressure is reached, it will lift the needle valve off its seat. When this occurs, the fuel is forced through the small orifices in the spray tip which injects atomized fuel into the combustion chamber. As stated earlier, at this time the intense heat created by the high compression of air immediately ignites the atomized fuel and combustion begins, starting your power stroke. The fuel remaining in the injector during this process flows through the injector for cooling and lubrication and returns to the fuel tank.

3. PROCEDURAL STEPS USED TO DISASSEMBLE DETROIT 8V92TA DIESEL ENGINE INTO SUBASSEMBLIES

a. Detailed instructions for disassembling the Detroit 8V92TA diesel engine are contained in the manuals that were issued to you at the beginning of this block of instruction. Follow those instructions carefully to effect those disassembly procedures on the training aid engine to which you have been assigned.

b. Have the instructor assigned to your station check your work at each point designated in this student handout.

c. Refer to TM 9-2320-297-20 and TM 9-2320-297-34 for the procedures used to perform the disassembly steps listed. The TM number will be listed out to the right of each step. Use the index to locate the instructions in the manual and read the instructions carefully before performing each task.

d. Remove the subassemblies and components.

(1) Loosen the two clamps and remove the exhaust extension from the turbocharger and muffler.

(2) Remove wiring harness. Do not remove ground wire from shutdown solenoid.

(3) Remove the exhaust crossover tube. (TM 9-2320-297-20, page 5-6)

(4) Remove the exhaust manifolds. (TM 9-2320-297-20, page 3-14)

(5) Remove the alternator. Do not remove adapter at this time. (TM 9-2320-297-20, page 7-8)

NOTE

Remove the air inlet elbow and filter assembly before proceding with step (6).

(6) Remove the turbocharger. (TM 9-2320-297-34, page 4-70)

STOP! Have instructor initial.

(7) Remove the air inlet housing. (TM 9-2320-297-34, page 4-82)

(8) Remove the rocker covers. (TM 9-2320-297-20, page 3-8)

(9) Remove the shutdown solenoid and mounting bracket as an assembly. (TM 9-2320-297-20, page 4-40)

(10) Remove the thermostats and housings. Do not remove the lower right thermostat housing. (TM 9-2320-297-20, page 6-8)

NOTE

Remove the fuel lines and fuel filter from the front of the engine. Disconnect the lines from the engine and fuel pump only. Do not remove the fuel manifold return line at this time.

STOP! Have instructor initial.

(11) Remove the fuel pump and fuel manifold return line. (TM 9-2320-297-20, page 4-4)

(12) Remove the blower. (TM 9-2320-297-34, page 4-34)

(13) Remove the injector control tubes. (TM 9-2320-297-34, page 4-28)

STOP! Have instructor initial.

(14) Remove the cylinder heads. (TM 9-2320-297-34, page 3-14)

(a) Remove left cylinder head.

STOP! Have instructor initial.

(b) Remove right cylinder head.

(c) Remove lower right thermostat housing.

STOP! Have instructor initial.

(15) Remove the aftercooler. (TM 9-2320-297-34, page 5-20)

(16) Remove the blower drive gear. (TM 9-2320-297-34, page 4-64)

NOTE

Remove the water pump cover and seal before performing step (17).

(17) Remove the water pump. (TM 9-2320-297-34, page 5-12)

STOP! Have instructor initial.

(18) Clean engine block and work station.

e. STOP! Do not proceed any further. Make sure all the engine subassemblies and components are stored out of the way and on the work tables. Have instructor initial.

4. PROCEDURAL STEPS USED TO REPAIR DETROIT 8V92TA DIESEL ENGINE SUBASSEMBLIES

a. Detailed instructions for repairing the Detroit 8V92TA diesel engine are contained in the manual that was issued to you at the beginning of this block of instruction. Follow those instructions carefully to effect those repair procedures on the training aid engine to which you have been assigned.

b. Have the instructor assigned to your station check your work at each point designated in this student handout.

c. Refer to TM 9-2320-297-34 for the procedures used to perform the repair steps listed. Use the index to locate the instructions in the manual and read the instructions carefully before performing each task.

d. Repair Detroit 8V92TA diesel engine cylinder head assembly.

NOTE

Break the torque on all push rod locknuts before removing brake assembly.

(1) Remove engine brake assembly. (page 3-92)

(2) Remove valve operating mechanism. Do not loosen or remove valve bridge adjustment screws. (page 3-58)

(3) Remove fuel injectors. (page 4-12)

(4) Remove valve assembly. (page 3-24)

(5) Clean cylinder heads, injectors, and valves.

STOP! Have instructor initial.

(6) Inspect cylinder heads for flatness. (page 3-26)

(a) Record maximum warpage.

(b) Record minimum cylinder head height.

(7) Inspect injector tubes.

(8) Inspect water nozzles.

(9) Measure exhaust valve guides. Record diameter.

(10) Inspect exhaust valve bridge guides.

(11) Inspect valve assembly.

(a) Record stem diameter.

(b) Record valve-to-guide clearance.

(12) Inspect cam follower bores. Record bore diameter.

STOP! Have instructor initial.

(13) Install exhaust valves. (page 3-35)

STOP! Have instructor initial.

e. Repair Detroit 8V92TA diesel engine valve operating mechanism. (page 3-60)

(1) Clean valve operating mechanism.

(2) Inspect valve operating mechanism for one cylinder.

(a) Measure inside diameter of rocker arm bushings. Record diameters.

(b) Measure outside diameter of rocker arm shaft. Record diameter.

(c) Record clearance between rocker arm shaft and rocker arm bushing.

(d) Check cam roller for out-of-roundness. Record measurements.

(e) Check side clearance. Record clearance.

(3) Inspect cam followers. Record cam follower diameter.

(4) Check cam follower-to-cam follower bore clearance. Record clearance.

(5) Replace cam follower pin if damaged.

(6) Install injectors. (page 4-13)

STOP! Have instructor initial.

(7) Install valve operating mechanism. (page 3-64)

(8) Check and adjust valve bridges as required.

STOP! Have instructor initial.

f. Repair Detroit 8V92TA diesel engine brake assembly. (page 3-93)

(1) Remove oil jumper tube.

(2) Remove control valve and springs.

(3) Remove solenoid valve.

(4) Remove slave piston.

(5) Remove master piston.

STOP! Have instructor initial.

(6) Inspect housing for cracks.

(7) Inspect pistons for wear.

(8) Inspect control valve for defects.

(9) Inspect solenoid valve for defects.

STOP! Have instructor initial.

(10) Install master piston.

(11) Install slave piston.

(12) Install solenoid valve. (Do not tighten at this time.)

(13) Install control valve.

(14) Install oil jumper tube.

STOP! Have instructor initial.

(15) Install engine brake assembly.

(16) Adjust all push rods on both cylinder heads until they are flush with the top of the clevis. Also loosen all jake brake adjusting screws.

STOP! Have instructor initial.

g. Repair Detroit 8V92TA diesel engine injector control tubes. (page 4-30)

(1) Remove bracket.

(2) Remove locknut and adjusting screw.

(3) Remove control levers.

(4) Inspect control tube components for wear and straightness.

(5) Inspect springs for damage.

STOP! Have instructor initial.

(6) Install control levers.

(7) Install adjusting screws and locknuts.

(8) Install brackets.

STOP! Have instructor initial.

h. Repair Detroit 8V92TA diesel engine blower drive gear. (page 4-66)

(1) Remove drive hub.

(2) Remove nut and lockwasher.

(3) Remove thrust washer and washer.

(4) Remove drive gear.

(5) Measure drive gear bushings. Record readings.

(6) Measure outside diameter of support shaft. Record readings.

(7) Check clearance between support shaft and bushings. Record clearances.

(8) Measure thickness of thrust washer. Record reading.

(9) Measure thickness of thrust bearings. Record readings.

STOP! Have instructor initial.

(10) Install thrust bearing and drive gear.

(11) Install thrust bearing and thrust washer.

(12) Install lockwasher and nut.

(13) Check clearance between thrust washer and thrust bearing Record clearance.

STOP! Have instructor initial.

(14) Install drive hub.

STOP! Have instructor initial.

i. Check Detroit 8V92TA diesel engine governor assembly for serviceability. (page 4-95 and 4-48)

(1) Inspect govenor and blower components for serviceability.

(2) Check front rotor end-clearance. (Page 4-56) Record clearance.

(3) Check rear rotor end-clearance. (Page 4-56) Record clearance.

(4) Check clearance for diagrams A and B. (page 4-58)

Diagram A, Point C.

D.

E.

F.

Diagram B, Point C.

D.

E.

F.

(5) Adjust the governor gap.

(a) Position the idle adjusting screw so that it extends approximately 3/8 of an inch from the face of the locknut.

(b) Rotate the governor weights until they are in a horizontal position. Insert the governor weight wedge tool (J35516) between the low-speed weight and the governor riser. The tapered face of the wedge should be against the riser and positioned between the flanges on the ends of the riser.

(c) Push the wedge as far to the bottom as it will go, forcing the weights against the maximum travel stop. Check to make sure the governor high-speed spring plunger is seated. If it's not seated, turn the high-speed retainer as required to seat the plunger.

(d) With the wedge in the bottom position, use a feeler gauge between the low-speed spring cap and the high-speed spring plunger to set the gap to .008 of an inch by turning the gap adjusting screw. Then tighten the governor gap adjusting screw locknut.

(e) Push down on the governor weight wedge tool to be sure it did not move while the gap was being set. Recheck the gap while holding the tool in position.

STOP! Have instructor initial.

j. Clean and inspect all other Detroit 8V92TA diesel engine components.

k. STOP! Do not proceed any further. Make sure all the engine subassemblies and components are stored out of the way and on the work tables. Cover those components which could get dirt or other particles inside of them. Have instructor initial.

5. PROCEDURAL STEPS USED TO ASSEMBLE THE DETROIT 8V92TA DIESEL ENGINE FROM SERVICEABLE SUBASSEMBLIES

a. Detailed instructions for assembling the Detroit 8V92TA diesel engine are contained in the manuals that were issued to you at the beginning of this block of instruction. Follow those instructions carefully to effect those assembly procedures on the training aid engine to which you have been assigned.

b. Have the instructor assigned to your station check your work at each point designated in your student handout.

c. Refer to TM 9-2320-297-20 and TM 9-2320-297-34 for the procedures used to perform the assembly steps listed. The TM number will be listed out to the right of each step. Use the index to locate the instructions in the manual and read the instructions carefully before performing each task.

d. Install the subassemblies and components.

(1) Install water pump. Torque capscrews to 35 ft. lbs. (TM 9-2320-297-34, page 5-12)

(a) Check backlash. Record reading.

(b) Install cover.

STOP! Have instructor initial.

(2) Install the aftercooler. Torque capscrews to 15 ft. lbs. (TM 9-2320-297-34, page 5-21)

STOP! Have instructor initial.

NOTE

INSTALL THE LOWER RIGHT THERMOSTAT HOUSING BEFORE INSTALLING THE RIGHT CYLINDER HEAD. TORQUE 3/8 CAPSCREWS TO 25 FT. LBS. AND THE 7/16 CAPSCREW TO 35 FT. LBS. (TM 9-2320-297-20, PAGE 6-8) HAVE INSTRUCTOR CHECK EACH HEAD JUST BEFORE LOWERING TO THE ENGINE BLOCK.

(3) Install the right cylinder head. Torque capscrews for lifting bracket to 35 ft. lbs. (TM 9-2320-297-34, page 3-18)

STOP! Have instructor initial.

(4) Install the left cylinder head. Torque capscrews for lifting bracket to 25 ft. lbs. for 3/8 and 35 ft. lbs. for 7/16 capscrews. (TM 9-2320-297-34, page 3-18)

STOP! Have instructor initial.

(5) Install the injector control tubes. (TM 9-2320-297-34, page 4-32)

STOP! Have instructor initial.

(6) Install the blower drive gear and breather tubes. Torque capscrews to 60 in. lbs. (TM 9-2320- 297-34, page 4-68)

STOP! Have instructor initial.

(7) Install the blower. Torque capscrews for governor cover to 66 in. lbs. (TM 9-2320-297-34, page 4-37)

STOP! Have instructor initial.

NOTE

INSTALL THE MANIFOLD FUEL RETURN LINE AND BRACKET.

(8) Install the fuel pump. Torque capscrews to 120 in. lbs. (TM 9-2320-297-20, page 4-4)

NOTE

INSTALL THE FUEL LINES AND FUEL FILTER ON THE FRONT OF THE ENGINE BEFORE INSTALLING THE LEFT THERMOSTAT HOUSING. TORQUE CAPSCREWS FOR FILTER BRACKET TO 20 FT. LBS.

STOP! Have instructor initial.

(9) Install the thermostats and housings. Torque capscrews for lower housing to 25 ft. lbs. for 3/8 and 35 ft. lbs. for 7/16 capscrews. (TM 9-2320-297-20, page 6-10)

STOP! Have instructor initial.

(10) Install the shutdown solenoid. Torque the 1/4 inch capscrew and nut to 75 in. lbs. (TM 9-2320-297-20, page 4-42)

STOP! Have instructor initial.

(11) Install the turbocharger. Torque capscrews and locknuts to 25 ft. lbs. (TM 9-2320-297-34, page 4-72)

(12) Install the air inlet housing. Torque capscrews to 15 ft. lbs. (TM 9-2320-297-34, page 4-82)

STOP! Have instructor initial.

(13) Install the exhaust manifold. (TM 9-2320-297-20, page 3-14)

(14) Torque the turbocharger adapter capscrews to 25 ft. lbs.

(15) Install the alternator. (TM 9-2320-297-20, page 7-10)

(16) Install the exhaust crossover tube. (TM 9-2320-297-20, page 5-6)

STOP! Have instructor initial.

(17) Install Wiring Harness

(a) Lay the wiring harness on the stand so the wire terminals are in the area where their components will be installed.

(b) Install the three wires from the Jacobs brake microprocessor switch; the top wire (713) and the two wires located at the center of the switch (714 and 839).

(c) Connect the Jacobs brake wire at each cylinder head; the right cylinder head wire (716) and the left cylinder head wire (715).

(d) Plug in the two tachometer wires (809 and 810) at the back of the engine.

(e) Install the two wires (147 and 32) to the indicator light temperature sending unit and wire (320) to the water temperature sending unit.

(f) Install the wires (817 and 19) on the upper terminal on the shutdown solenoid.

(g) Install wires on alternator.

(a) Install the wires (278 and 820), lockwashers, and nut on the positive terminal.

(b) Install the wires (128 and 815), lockwashers, and nut on the negative terminal.

(c) Install the wire (831), star washer, and nut on the ignition (IGN) terminal.

NOTE

INSTALL THE AIR INLET HOSE, FILTER, AND FILTER SHIELD ON THE TURBOCHARGER AND HOUSING. TORQUE CAPSCREWS TO 30 FT. LBS. INSTALL THE EXHAUST EXTENSION ON THE TURBOCHARGER AND MUFFLER.

e. STOP! Do not proceed any further. Secure your tool box and clear your work area. Turn in all special tools and dispose of any unserviceable parts or material. Have instructor initial.

4. PROCEDURAL STEPS USED FOR FINAL ADJUSTMENTS AND RUN-IN OF THE DETROIT 8V92TA DIESEL ENGINE

a. Detailed instructions for the final adjustments of the Detroit 8V92TA diesel engine are contained in TM 9-2320-297-34 that was issued to you at the beginning of this block of instruction. Follow those instructions carefully to effect those adjustment procedures on the training aid engine to which you have been assigned.

NOTE

The instructor will be present throughout this practical application exercise.

b. Adjust exhaust valve clearance (cold engine). (page 3-200)

STOP! Have instructor initial.

c. Adjust Jacobs brake.

STOP! Have instructor initial.

d. Time fuel injectors. Install solenoid valve and tighten to 60 inch pounds or one quarter turn from the position where the valve is felt to firmly contact the rubber seal ring.

STOP! Have instructor initial.

e. Adjust injector rack control levers. lL _____________1R

STOP! Have instructor initial.

f. Adjust throttle delay.

STOP! Have instructor initial.

g. Install ignition cart. (Instructor will cover the procedures when team is ready.)

STOP! Have instructor initial.

h. Adjust maximum no-load engine speed.

STOP! Have instructor initial.

i. Adjust idle speed.

STOP! Have instructor initial.

j. Adjust buffer screw.

STOP! Have instructor initial.

k. Adjust exhaust valve clearance (hot engine).

STOP! Have instructor initial.

l. Remove ignition cart. (Instructor will cover the procedures when team is ready.)

STOP! Have instructor initial.

m. Install rocker covers. (TM 9-2320-297-20, page 3-9)

STOP! Have instructor initial.

n. Install high speed retainer cover. Torque capscrews to 60 in. lbs.

STOP! Have instructor initial.

o. Turn in all unused parts or materials. Lay out all special and common tools on the work table for inventory. Notify the instructor when you have your tools ready for inventory.

REFERENCES:

TM 9-2320-297-20
TM 9-2320-297-34